

**SINGLE-CHANNEL**  
**6N137**  
**HCPL-2601**  
**HCPL-2611**

**DUAL-CHANNEL**  
**HCPL-2630**  
**HCPL-2631**

**DESCRIPTION**

The 6N137, HCPL-2601/2611 single-channel and HCPL-2630/2631 dual-channel optocouplers consist of a 850 nm AlGaAs LED, optically coupled to a very high speed integrated photodetector logic gate with a strobable output. This output features an open collector, thereby permitting wired OR outputs. The coupled parameters are guaranteed over the temperature range of -40°C to +85°C. A maximum input signal of 5 mA will provide a minimum output sink current of 13 mA (fan out of 8).

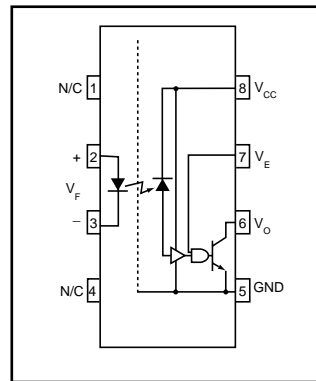
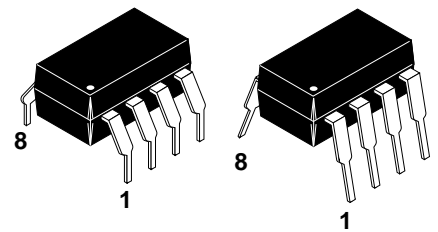
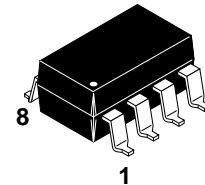
An internal noise shield provides superior common mode rejection of typically 10 kV/μs. The HCPL-2601 and HCPL-2631 has a minimum CMR of 5 kV/μs. The HCPL-2611 has a minimum CMR of 10 kV/μs.

**FEATURES**

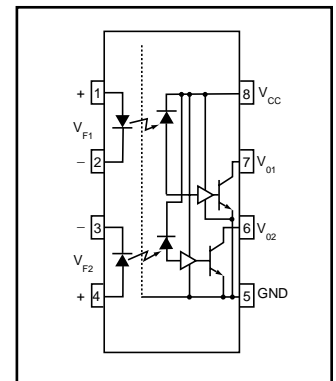
- Very high speed-10 MBit/s
- Superior CMR-10 kV/μs
- Double working voltage-480V
- Fan-out of 8 over -40°C to +85°C
- Logic gate output
- Storable output
- Wired OR-open collector
- U.L. recognized (File # E90700)

**APPLICATIONS**

- Ground loop elimination
- LSTTL to TTL, LSTTL or 5-volt CMOS
- Line receiver, data transmission
- Data multiplexing
- Switching power supplies
- Pulse transformer replacement
- Computer-peripheral interface



Single-channel circuit drawing



Dual-channel circuit drawing

TRUTH TABLE  
(Positive Logic)

Input	Enable	Output
H	H	L
L	H	H
H	L	H
L	L	H
H	NC	L
L	NC	H

A 0.1 μF bypass capacitor must be connected between pins 8 and 5.  
(See note 1)

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## ABSOLUTE MAXIMUM RATINGS (No derating required up to 85°C)

Parameter	Symbol	Value	Units
Storage Temperature	$T_{STG}$	-55 to +125	°C
Operating Temperature	$T_{OPR}$	-40 to +85	°C
Lead Solder Temperature	$T_{SOL}$	260 for 10 sec	°C
<b>EMITTER</b>			
DC/Average Forward Input Current	$I_F$	50	mA
Single channel			
Dual channel (Each channel)		30	
Enable Input Voltage	$V_E$	5.5	V
Single channel			
Not to exceed $V_{CC}$ by more than 500 mV			
Reverse Input Voltage	$V_R$	5.0	V
Power Dissipation	$P_I$	100	mW
		Single channel	
Dual channel (Each channel)		45	
<b>DETECTOR</b>			
Supply Voltage	$V_{CC}$ (1 minute max)	7.0	V
Output Current	$I_O$	50	mA
		Single channel	
Dual channel (Each channel)		50	
Output Voltage	$V_O$	7.0	V
Collector Output	$P_O$	85	mW
Single channel			
Dual channel (Each channel)		60	

## RECOMMENDED OPERATING CONDITIONS

Parameter	Symbol	Min	Max	Units
Input Current, Low Level	$I_{FL}$	0	250	μA
Input Current, High Level	$I_{FH}$	*6.3	15	mA
Supply Voltage, Output	$V_{CC}$	4.5	5.5	V
Enable Voltage, Low Level	$V_{EL}$	0	0.8	V
Enable Voltage, High Level	$V_{EH}$	2.0	$V_{CC}$	V
Low Level Supply Current	$T_A$	-40	+85	°C
Fan Out (TTL load)	N		8	

\* 6.3 mA is a guard banded value which allows for at least 20 % CTR degradation. Initial input current threshold value is 5.0 mA or less

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## ELECTRICAL CHARACTERISTICS (T<sub>A</sub> = -40°C to +85°C Unless otherwise specified.)

### INDIVIDUAL COMPONENT CHARACTERISTICS

Parameter	Test Conditions	Symbol	Min	Typ**	Max	Unit
<b>EMITTER</b>						
Input Forward Voltage	(I <sub>F</sub> = 10 mA) T <sub>A</sub> = 25°C	V <sub>F</sub>		1.4	1.8	V
Input Reverse Breakdown Voltage	(I <sub>R</sub> = 10 μA)	B <sub>VR</sub>	5.0			V
Input Capacitance	(V <sub>F</sub> = 0, f = 1 MHz)	C <sub>IN</sub>		60		pF
Input Diode Temperature Coefficient	(I <sub>F</sub> = 10 mA)	ΔV <sub>F</sub> /ΔT <sub>A</sub>		-1.4		mV/°C
<b>DETECTOR</b>						
High Level Supply Current	Single Channel (V <sub>CC</sub> = 5.5 V, I <sub>F</sub> = 0 mA) Dual Channel (V <sub>E</sub> = 0.5 V)	I <sub>CCH</sub>		7	10	mA
Low Level Supply Current	Single Channel (V <sub>CC</sub> = 5.5 V, I <sub>F</sub> = 10 mA) Dual Channel (V <sub>E</sub> = 0.5 V)	I <sub>CCL</sub>		9	13	mA
Low Level Enable Current	(V <sub>CC</sub> = 5.5 V, V <sub>E</sub> = 0.5 V)	I <sub>EL</sub>		-0.8	-1.6	mA
High Level Enable Current	(V <sub>CC</sub> = 5.5 V, V <sub>E</sub> = 2.0 V)	I <sub>EH</sub>		-0.6	-1.6	mA
High Level Enable Voltage	(V <sub>CC</sub> = 5.5 V, I <sub>F</sub> = 10 mA)	V <sub>EH</sub>	2.0			V
Low Level Enable Voltage	(V <sub>CC</sub> = 5.5 V, I <sub>F</sub> = 10 mA) (Note 3)	V <sub>EL</sub>			0.8	V

## SWITCHING CHARACTERISTICS (T<sub>A</sub> = -40°C to +85°C, V<sub>CC</sub> = 5 V, I<sub>F</sub> = 7.5 mA Unless otherwise specified.)

AC Characteristics	Test Conditions	Symbol	Min	Typ**	Max	Unit
Propagation Delay Time to Output High Level	(Note 4) (T <sub>A</sub> = 25°C) (R <sub>L</sub> = 350 Ω, C <sub>L</sub> = 15 pF) (Fig. 12)	T <sub>PLH</sub>	20	45	75	ns
Propagation Delay Time to Output Low Level	(Note 5) (T <sub>A</sub> = 25°C) (R <sub>L</sub> = 350 Ω, C <sub>L</sub> = 15 pF) (Fig. 12)	T <sub>PHL</sub>	25	45	75	ns
Pulse Width Distortion	(R <sub>L</sub> = 350 Ω, C <sub>L</sub> = 15 pF) (Fig. 12)	T <sub>PHL</sub> - T <sub>PLH</sub>		3	35	ns
Output Rise Time (10-90%)	(R <sub>L</sub> = 350 Ω, C <sub>L</sub> = 15 pF) (Note 6) (Fig. 12)	t <sub>r</sub>		50		ns
Output Fall Time (90-10%)	(R <sub>L</sub> = 350 Ω, C <sub>L</sub> = 15 pF) (Note 7) (Fig. 12)	t <sub>f</sub>		12		ns
Enable Propagation Delay Time to Output High Level	(I <sub>F</sub> = 7.5 mA, V <sub>EH</sub> = 3.5 V) (R <sub>L</sub> = 350 Ω, C <sub>L</sub> = 15 pF) (Note 8) (Fig. 13)	t <sub>ELH</sub>		20		ns
Enable Propagation Delay Time to Output Low Level	(I <sub>F</sub> = 7.5 mA, V <sub>EH</sub> = 3.5 V) (R <sub>L</sub> = 350 Ω, C <sub>L</sub> = 15 pF) (Note 9) (Fig. 13)	t <sub>EHL</sub>		20		ns
Common Mode Transient Immunity (at Output High Level)	(T <sub>A</sub> = 25°C)  V <sub>CM</sub>   = 50 V, (Peak) (I <sub>F</sub> = 0 mA, V <sub>OH</sub> (Min.) = 2.0 V)	C <sub>MH</sub>				V/μs
	6N137, HCPL-2630 (R <sub>L</sub> = 350 Ω) (Note 10)			10,000		
	HCPL-2601, HCPL-2631 (Fig. 14)		5000	10,000		
	HCPL-2611  V <sub>CM</sub>   = 400 V		10,000	15,000		
Common Mode Transient Immunity (at Output Low Level)	(R <sub>L</sub> = 350 Ω) (I <sub>F</sub> = 7.5 mA, V <sub>OL</sub> (Max.) = 0.8 V) (T <sub>A</sub> = 25°C)	C <sub>ML</sub>				V/μs
	6N137, HCPL-2630  V <sub>CM</sub>   = 50 V (Peak)			10,000		
	HCPL-2601, HCPL-2631 (Note 11) (Fig. 14)		5000	10,000		
	HCPL-2611 (T <sub>A</sub> = 25°C)  V <sub>CM</sub>   = 400 V		10,000	15,000		

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## TRANSFER CHARACTERISTICS (T<sub>A</sub> = -40°C to +85°C Unless otherwise specified.)

DC Characteristics	Test Conditions	Symbol	Min	Typ**	Max	Unit
High Level Output Current	(V <sub>CC</sub> = 5.5 V, V <sub>O</sub> = 5.5 V) (I <sub>F</sub> = 250 μA, V <sub>E</sub> = 2.0 V) (Note 2)	I <sub>OH</sub>			100	μA
Low Level Output Current	(V <sub>CC</sub> = 5.5 V, I <sub>F</sub> = 5 mA) (V <sub>E</sub> = 2.0 V, I <sub>CL</sub> = 13 mA) (Note 2)	V <sub>OL</sub>		.35	0.6	V
Input Threshold Current	(V <sub>CC</sub> = 5.5 V, V <sub>O</sub> = 0.6 V, V <sub>E</sub> = 2.0 V, I <sub>OL</sub> = 13 mA)	I <sub>FT</sub>		3	5	mA

## ISOLATION CHARACTERISTICS (T<sub>A</sub> = -40°C to +85°C Unless otherwise specified.)

Characteristics	Test Conditions	Symbol	Min	Typ**	Max	Unit
Input-Output Insulation Leakage Current	(Relative humidity = 45%) (T <sub>A</sub> = 25°C, t = 5 s) (V <sub>I-O</sub> = 3000 VDC) (Note 12)	I <sub>I-O</sub>			1.0*	μA
Withstand Insulation Test Voltage	(RH < 50%, T <sub>A</sub> = 25°C) (Note 12) ( t = 1 min.)	V <sub>ISO</sub>	2500			V <sub>RMS</sub>
Resistance (Input to Output)	(V <sub>I-O</sub> = 500 V) (Note 12)	R <sub>I-O</sub>		10 <sup>12</sup>		Ω
Capacitance (Input to Output)	(f = 1 MHz) (Note 12)	C <sub>I-O</sub>		0.6		pF

\*\* All typical values are at V<sub>CC</sub> = 5 V, T<sub>A</sub> = 25°C

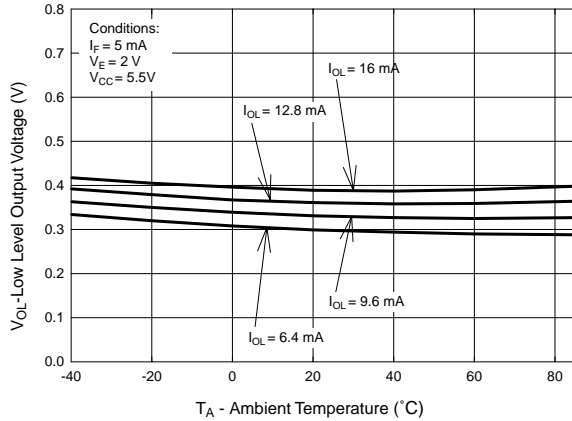
## NOTES

- The V<sub>CC</sub> supply to each optoisolator must be bypassed by a 0.1μF capacitor or larger. This can be either a ceramic or solid tantalum capacitor with good high frequency characteristic and should be connected as close as possible to the package V<sub>CC</sub> and GND pins of each device.
- Each channel.
- Enable Input - No pull up resistor required as the device has an internal pull up resistor.
- t<sub>PLH</sub> - Propagation delay is measured from the 3.75 mA level on the HIGH to LOW transition of the input current pulse to the 1.5 V level on the LOW to HIGH transition of the output voltage pulse.
- t<sub>PHL</sub> - Propagation delay is measured from the 3.75 mA level on the LOW to HIGH transition of the input current pulse to the 1.5 V level on the HIGH to LOW transition of the output voltage pulse.
- t<sub>r</sub> - Rise time is measured from the 90% to the 10% levels on the LOW to HIGH transition of the output pulse.
- t<sub>f</sub> - Fall time is measured from the 10% to the 90% levels on the HIGH to LOW transition of the output pulse.
- t<sub>ELH</sub> - Enable input propagation delay is measured from the 1.5 V level on the HIGH to LOW transition of the input voltage pulse to the 1.5 V level on the LOW to HIGH transition of the output voltage pulse.
- t<sub>EHL</sub> - Enable input propagation delay is measured from the 1.5 V level on the LOW to HIGH transition of the input voltage pulse to the 1.5 V level on the HIGH to LOW transition of the output voltage pulse.
- CM<sub>H</sub> - The maximum tolerable rate of rise of the common mode voltage to ensure the output will remain in the high state (i.e., V<sub>OUT</sub> > 2.0 V). Measured in volts per microsecond (V/μs).
- CM<sub>L</sub> - The maximum tolerable rate of rise of the common mode voltage to ensure the output will remain in the low output state (i.e., V<sub>OUT</sub> < 0.8 V). Measured in volts per microsecond (V/μs).
- Device considered a two-terminal device: Pins 1,2,3 and 4 shorted together, and Pins 5,6,7 and 8 shorted together.

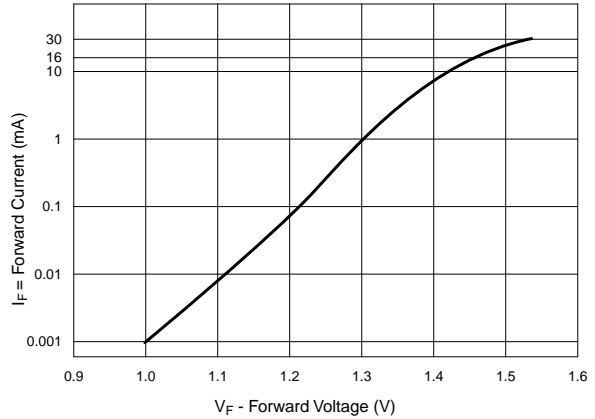
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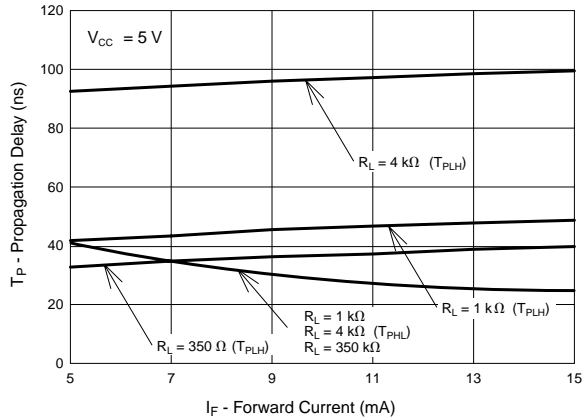
**Fig.1 Low Level Output Voltage vs. Ambient Temperature**



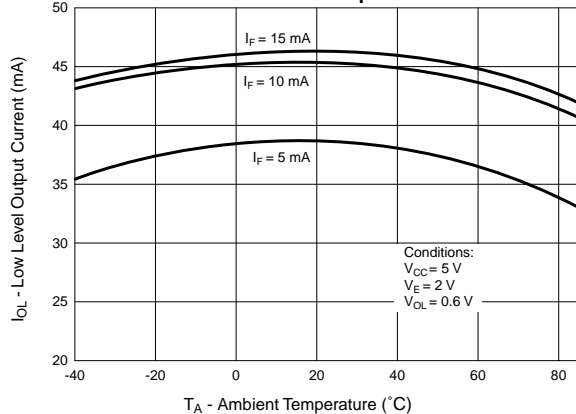
**Fig. 2 Input Diode Forward Voltage vs. Forward Current**



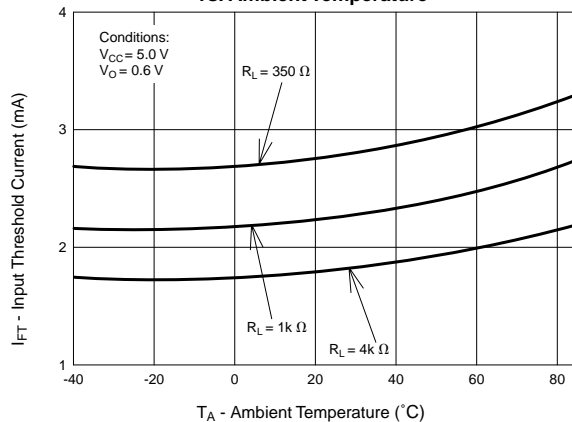
**Fig.3 Switching Time vs. Forward Current**



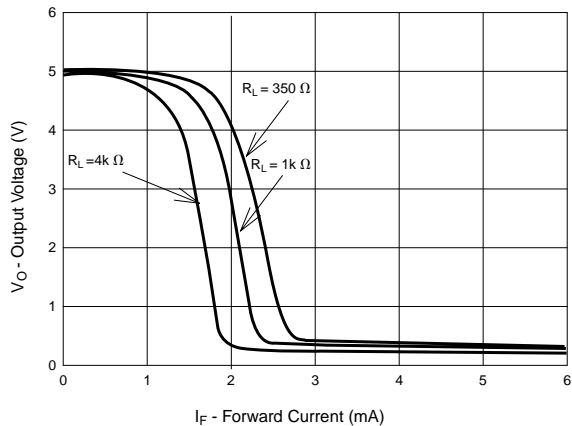
**Fig. 4 Low Level Output Current vs. Ambient Temperature**



**Fig. 5 Input Threshold Current vs. Ambient Temperature**



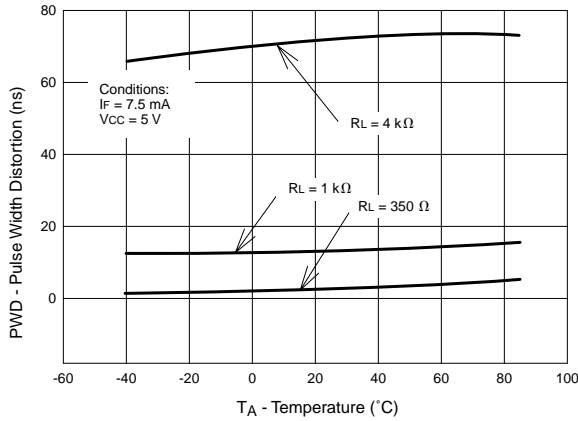
**Fig. 6 Output Voltage vs. Input Forward Current**



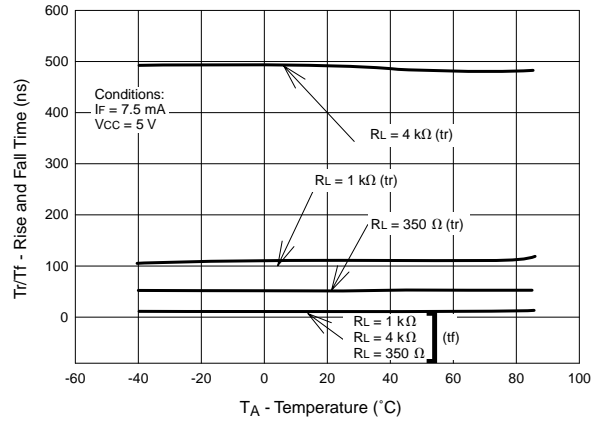
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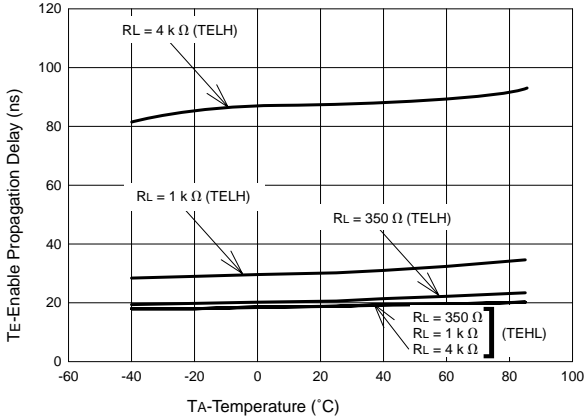
**Fig. 7 Pulse Width Distortion vs. Temperature**



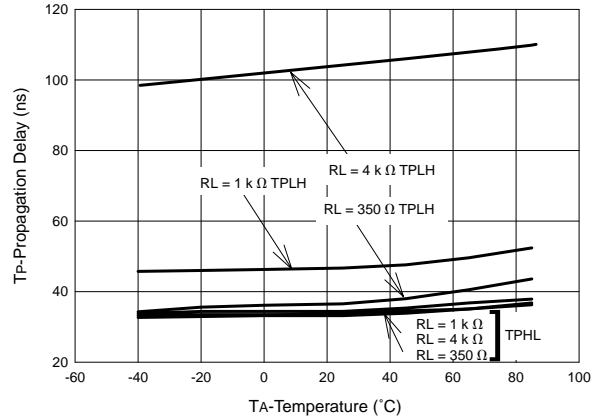
**Fig. 8 Rise and Fall Time vs. Temperature**



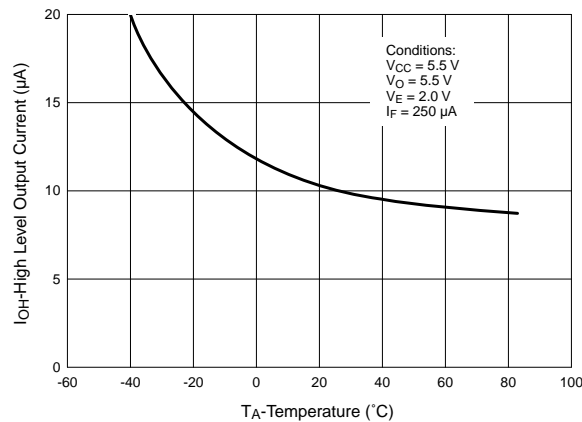
**Fig. 9 Enable Propagation Delay vs. Temperature**



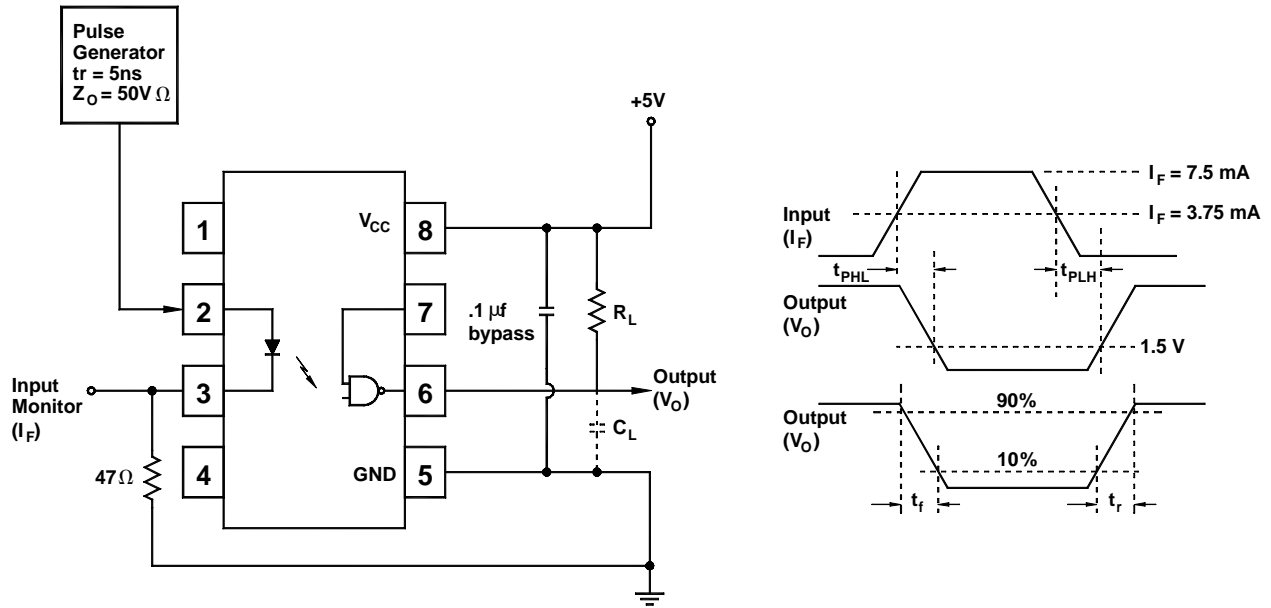
**Fig. 10 Switching Time vs. Temperature**



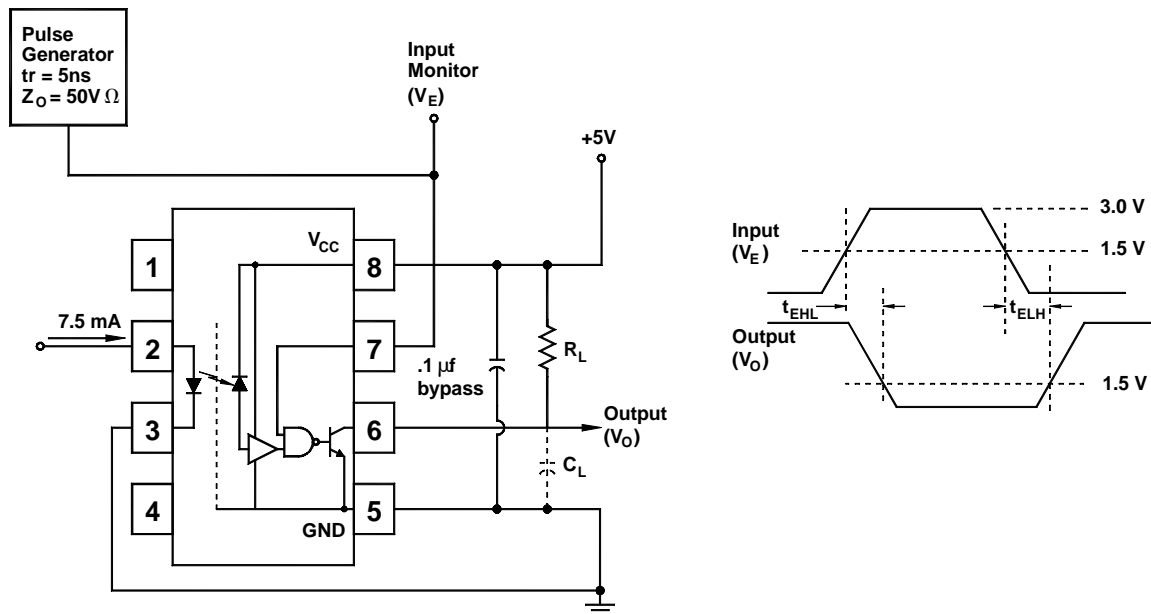
**Fig. 11 High Level Output Current vs. Temperature**



<b>SINGLE-CHANNEL</b> <b>6N137</b> <b>HCPL-2601</b> <b>HCPL-2611</b>	<b>DUAL-CHANNEL</b> <b>HCPL-2630</b> <b>HCPL-2631</b>
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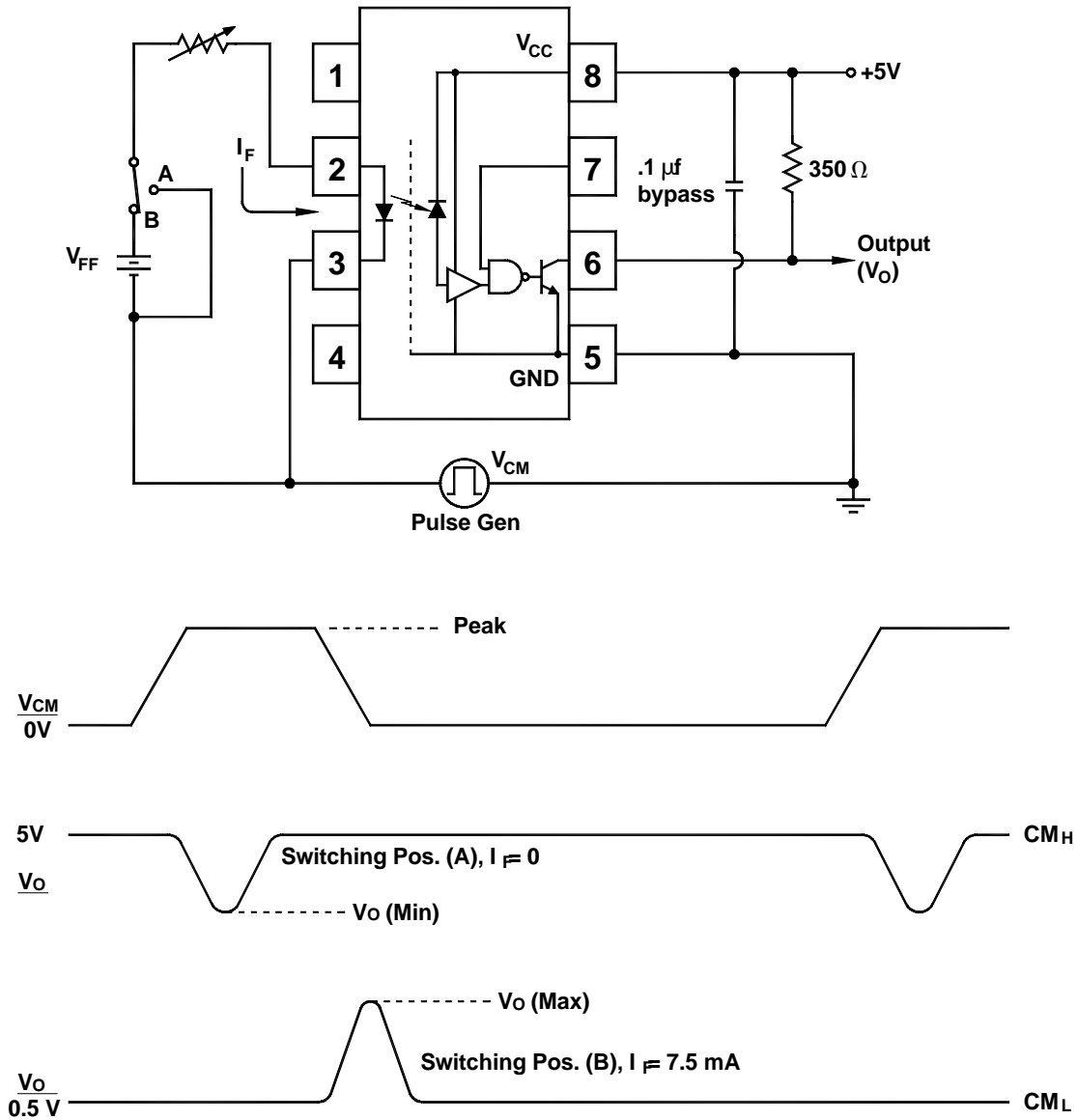


**Fig. 12 Test Circuit and Waveforms for  $t_{PLH}$ ,  $t_{PHL}$ ,  $t_r$  and  $t_f$ .**



**Fig. 13 Test Circuit  $t_{EHL}$  and  $t_{ELH}$ .**

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<b>HCPL-2611</b>	



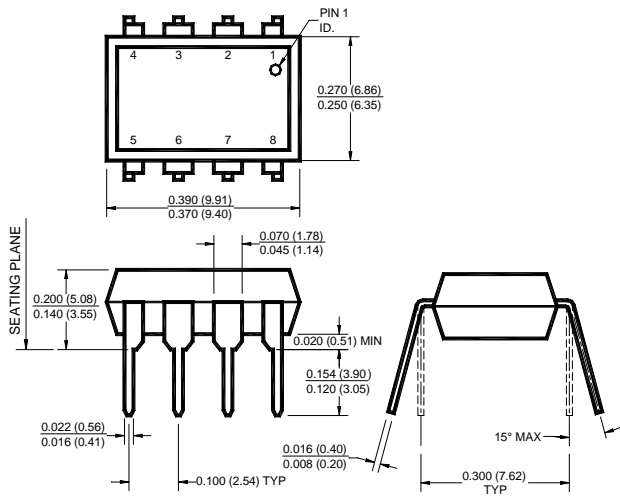
**Fig. 14 Test Circuit Common Mode Transient Immunity**



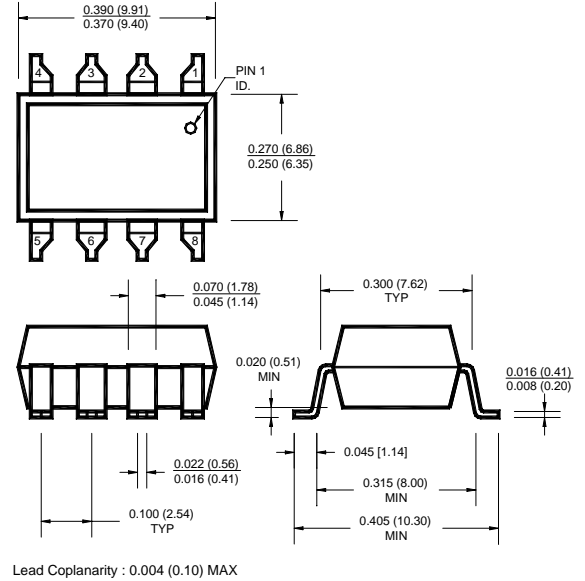
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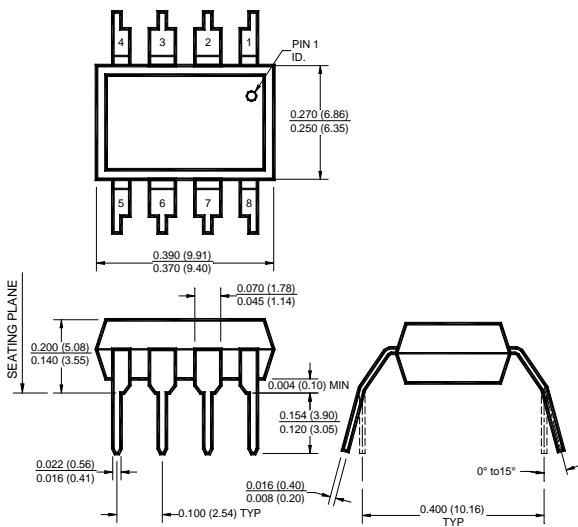
### Package Dimensions (Through Hole)



### Package Dimensions (Surface Mount)



### Package Dimensions (0.4" Lead Spacing)



**NOTE**

All dimensions are in inches (millimeters)

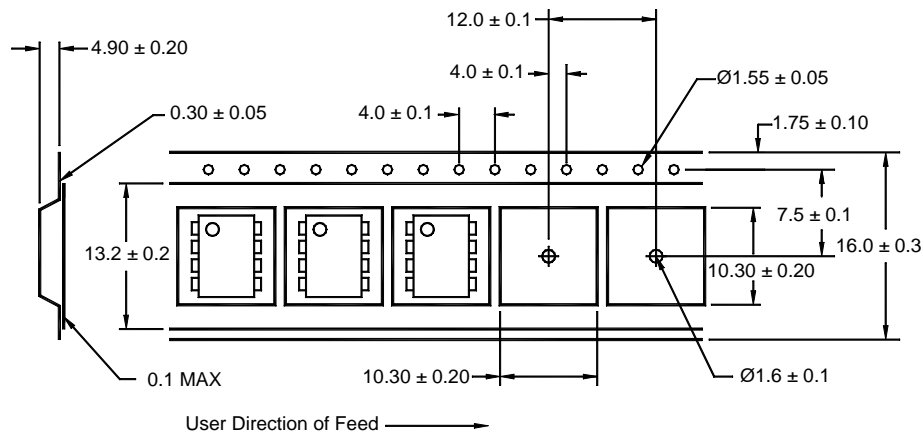
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## ORDERING INFORMATION

Option	Order Entry Identifier	Description
S	.S	Surface Mount Lead Bend
SD	.SD	Surface Mount; Tape and reel
W	.W	0.4" Lead Spacing

## QT Carrier Tape Specifications ("D" Taping Orientation)



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1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, and (c) whose failure to perform when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury of the user.
2. A critical component in any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.